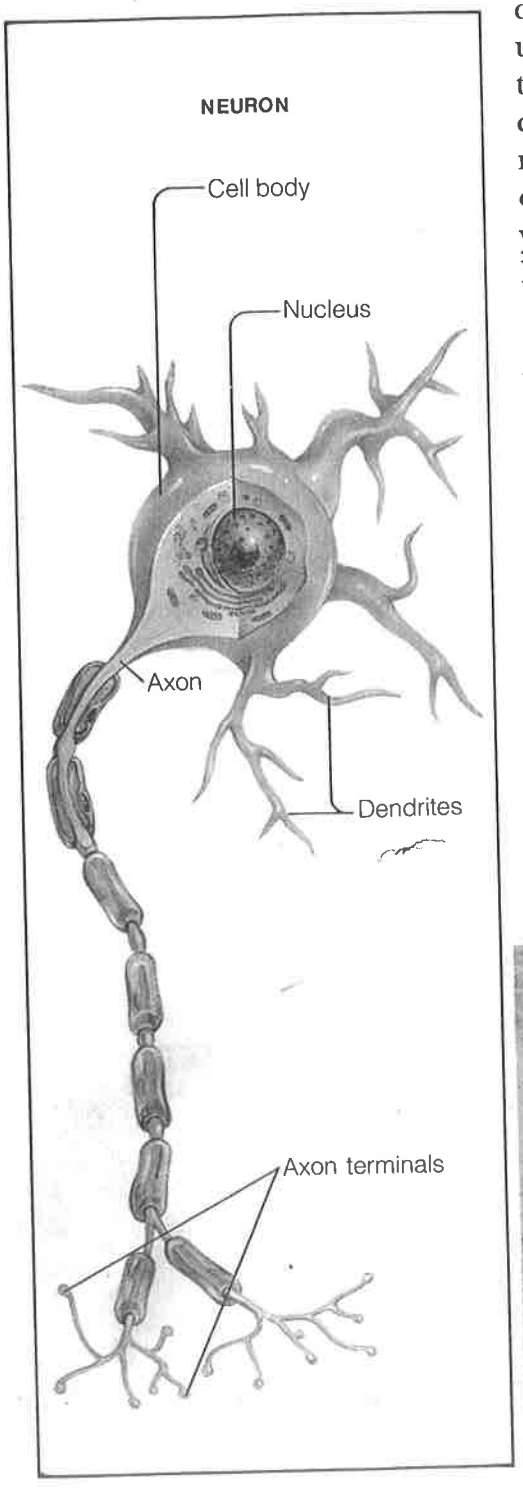
The Neuron—A Message-Carrying Cell

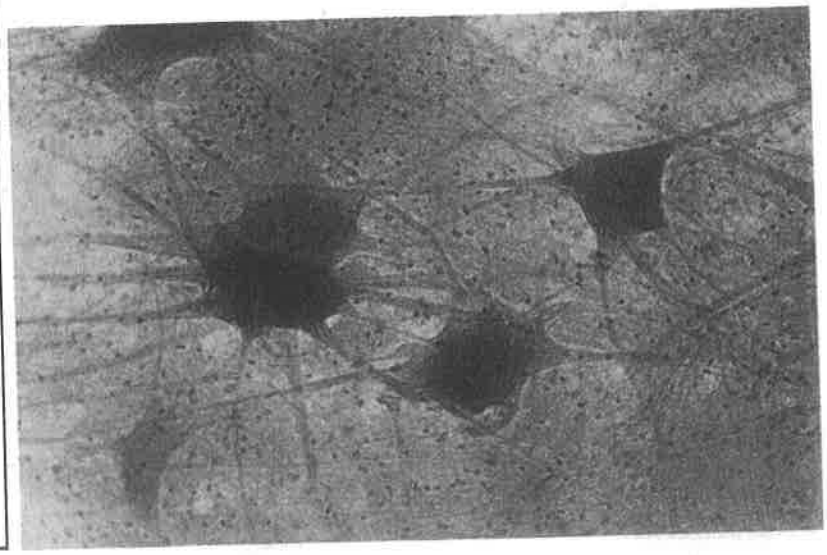
The nervous system is constantly alive with activity. It buzzes with messages that run to and from all parts of the body. Every second, hundreds of these messages make their journey through the body. The messages are carried by strings of one-of-a-kind cells called **neurons,** or nerve cells. Neurons are the basic units of structure and function in the nervous system. Neurons are unique because, unlike most other cells in the body, they can never be replaced. You need not worry about this, however. The number of neurons that you are born with is so large that you will have more than enough to last your entire lifetime.

Although neurons come in all shapes and sizes, they share certain basic characteristics, or features. You can see the features of a typical neuron in Figure 6–3. Notice that the largest part of the neuron is the **cell body.** The cell body contains the nucleus (a large dark structure), which controls all the activities of the cell.

You can think of the cell body as the switchboard of the message-carrying neuron. Running into this switchboard are one or more tiny, branching, thread-like structures called **dendrites.** The dendrites carry messages to the cell body of a neuron. A long tail-like fiber called an **axon** carries messages away from the cell body. Each neuron has only one axon, but the axon can be anywhere from 1 millimeter to more than 1 meter in length!

Figure 6–3 *Use the diagram to identify the basic structures in these neurons from the spinal cord. What is the function of the cell body?*





Notice in Figure 6–3 that the axon splits into many featherlike fibers at its far end. These fibers are called axon terminals (ends). Axon terminals pass on messages to the dendrites of other neurons. Axon terminals are usually found some distance from the cell body.

There are three types of neurons in your nervous system—sensory neurons, interneurons, and motor neurons. To find out the function of each neuron, try this activity: Press your finger against the edge of your desk. What happens? You feel the pressure of the desk pushing into your skin. You may even feel some discomfort or pain, if you press hard enough. Eventually, you remove your finger from this position.

How do neurons enable you to do all this? Special cells known as **receptors** receive information from your surroundings. In this activity the receptors are located in your finger. Messages travel from these receptors to your spinal cord and brain through **sensory neurons.** Your spinal cord and brain contain **interneurons.** Interneurons connect sensory neurons to **motor neurons.** It is through motor neurons that the messages from your brain and spinal cord are sent to a muscle cell or gland cell in your body. The muscle cell or gland cell that is stimulated by the motor neuron is called an **effector.**

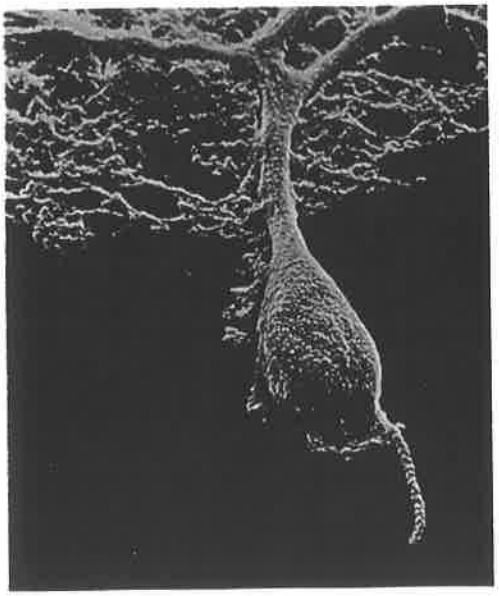
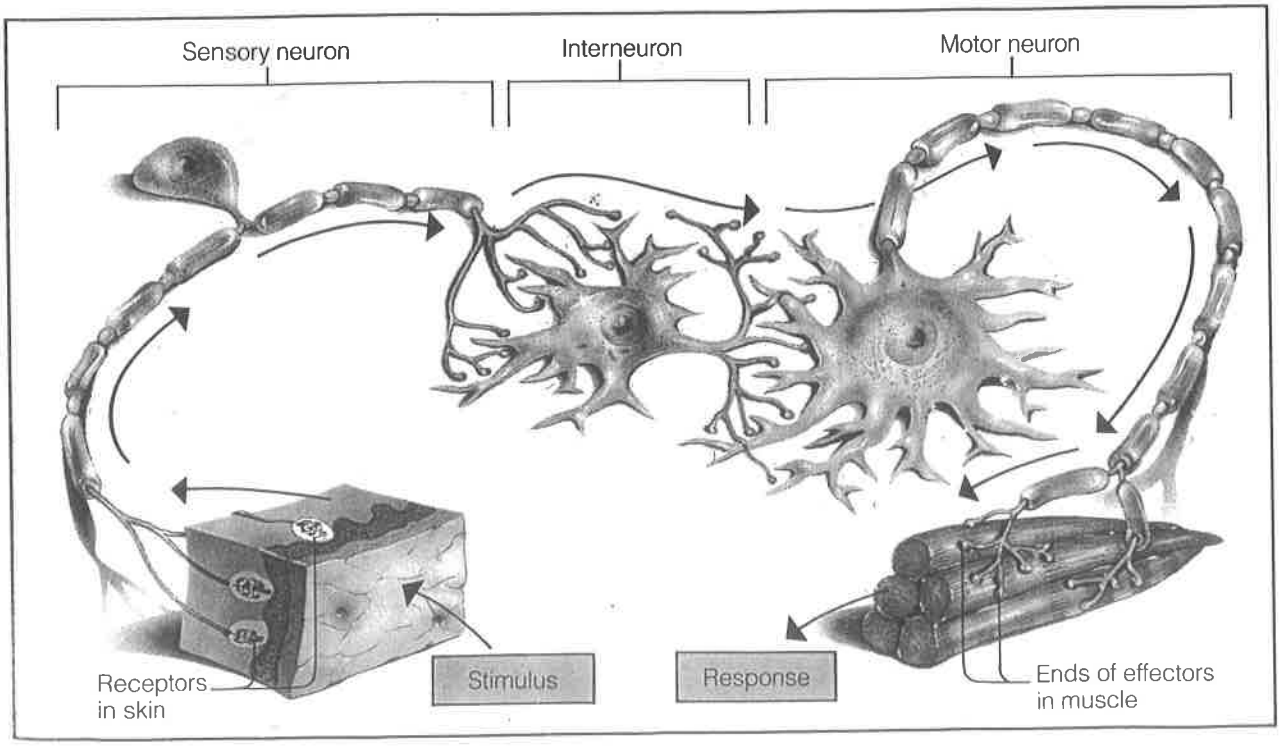


Figure 6–4 *One of the body's billions of neurons can be seen in this photograph. The axon is the ropelike structure at the bottom of the photograph. What is the function of the axon?*

Figure 6–5 *There are three types of neurons in the nervous system: sensory neurons, interneurons, and motor neurons. What is an effector? A receptor?*

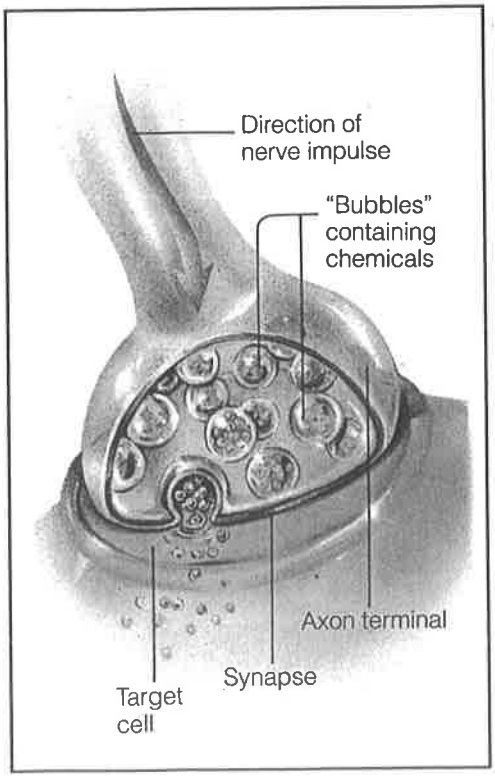


The Nerve Impulse

You have just read that the path of a message, which is more accurately known as a **nerve impulse,** is basically from sensory neuron to interneuron to motor neuron. But how exactly does a message travel along a neuron? And how does it get from one neuron to another neuron? **When a nerve impulse travels along a neuron or from one neuron to another neuron, it does so in the form of electrical and chemical signals.**

An electrical signal, which in simple terms is thought of as changing positive and negative charges, moves a nerve impulse along a neuron (or from one end of the neuron to the other). The nerve impulse enters the neuron through the dendrites and travels along the length of the axon. The speed at which a nerve impulse travels along a neuron can be as fast as 120 meters per second!

The way in which a nerve impulse travels from one neuron to another is a bit more complex. Do you know why? The reason is that the neurons do not touch one another. There is a tiny gap called a **synapse** (SIHN-aps) between the two neurons. Somehow, the nerve impulse must "jump" that gap. But how? Think of the synapse as a river that flows between a road on either bank. When a car gets to the



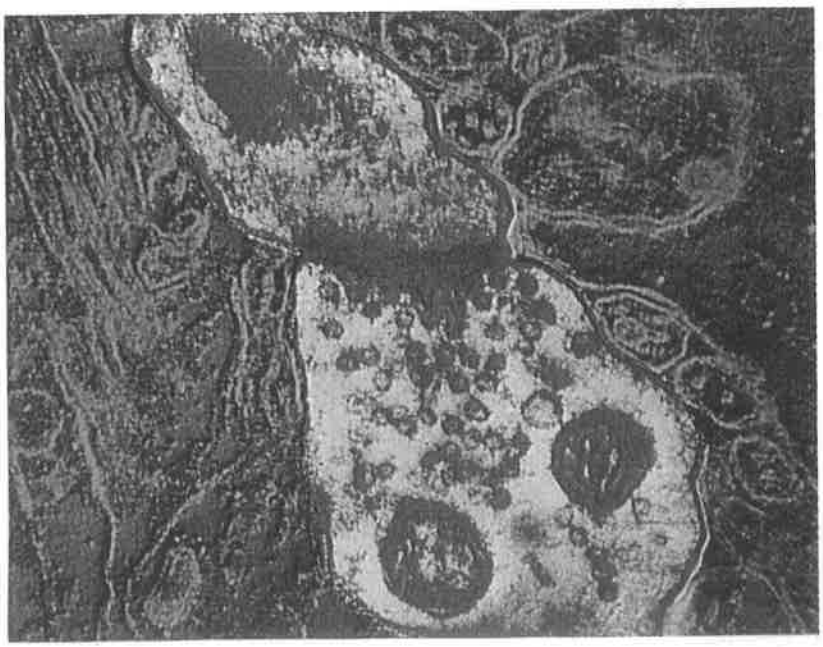


Figure 6–6 *The tiny gap between two neurons is called a synapse. The small reddish circles in the photograph are bubbles that contain chemicals which pour out of the axon terminal in one neuron, cross the synapse, and trigger a nerve impulse in the second neuron.*

river, it crosses over by ferry. Then it drives right back onto the road and continues its journey.

Similarly, a nerve impulse is "ferried" across the synapse by a chemical signal. This chemical signal pours out of the ends of the neuron (axon terminals) as the nerve impulse nears the synapse. The electrical signal that brought the nerve impulse to this point shuts down, and the chemical signal takes the nerve impulse aboard, moving it across the synapse to the next neuron along its route. Then the chemical signal triggers the electrical signal again, and the whole process is repeated until the nerve impulse reaches its destination. You can appreciate how efficient this process is when you consider that for certain actions, this all happens in a matter of milliseconds!

6–1 Section Review

1. What are the functions of the nervous system?
2. What is a neuron? Describe its structure.
3. Identify the three types of neurons.
4. Describe a nerve impulse.

Critical Thinking—*Making Comparisons*

5. In the human nervous system, nerve impulses travel in only one direction along a neuron. How is this one-way traffic system better than a two-way traffic system along the same neuron?

ACTIVITY DISCOVERING

A Reflex Action

1. Sit with your legs crossed so that one swings freely.

2. Using the side of your hand, gently strike your free-swinging leg just below your knee.

What happened when you struck that area? Describe in words or with a diagram the path the nerve impulse took as it traveled from your leg to the central nervous system and back to your leg.

■ What advantage does a reflex have over a response that involves a conscious choice?

6–2 Divisions of the Nervous System

Guide for Reading

Focus on these questions as you read.

- *What are the two major parts of the human nervous system?*
- *What is the function and structure of each of the two major parts of the human nervous system?*

In the previous section, you learned about the neuron as the basic unit of structure and function of the nervous system. You also gained some insight into the amazing job neurons do to keep you and your body in touch with the world inside and around you. Neurons, however, do not act alone. Instead, they are joined to form a complex communication network that makes up the human nervous